[From the American Practitioner and News for March and April, 1886.]

Erysipelas and Other Septic and Infectious Diseases Incident to Injuries and Surgical Operations Prevented by a Method of

ATMOSPHERIC PURIFICATION.

(SECOND PRESENTATION.)

WITH AN ORIGINAL AND NEW WOOD-CUT, AND WITH A REPORT OF CASES OF LAPAROTOMY.

By DAVID PRINCE, M.D., Jacksonville, Ill.

This paper is made up with the conviction that it presents an advance in the art of avoiding some of the enemies of life. The skin and mucous membranes constitute a barrier to the entrance of floating material acting as a poison when it gains access to the living solids and fluids. Some of these atmospheric agents are capable of entering by the lungs, without a previous breach of surface, and the presence or absence of these agents in the air (like the contagium of malarial fever), constitute an important element in the question of the healthfulness of a dwelling place. Other agents, like the contagium of erysipelas, may localize themselves in a habitation, so that the danger of infection continues a long time after the apparent cause has been removed.

Until within a few years, and before the observations with which the name of Joseph Lister is indissolubly associated, the infection inhering in the atmosphere of hospitals was a mystery. It eluded observation and investigation. It defied every attempt at removal by cleansing and the replacing of wall paper and plastering; in short, everything except the complete destruction of the building itself. The difficulty in keeping hospitals free from infection led many to the conviction that they should always be built with reference to their being torn down after a temporary use. We now know that the prevention of such inhering infection in a building, is the avoidance of the first case of disease, or such management of it by antiseptic agents, as will limit the production of the contagium to the smallest possible quantity, and neutralize that which is unavoidably produced. By antiseptics and ventilation, the problem as to house infection has been pretty well worked out.

The problem attempted to be solved in this paper, is to secure in an apartment for any convenient length of time, an atmosphere more pure than the out-door air, so that a room or any number of them, may continue, as long as the machinery is in operation, to contain an atmosphere as pure as that of a mountain top.

The evidence is complete that erysipelas and some other septic infections, are capable of being propagated by the products of a previous disease of the same kind.

The experimental evidence by inoculation may be illustrated by a quotation:

In the "Monograph on Micro-organisms and Disease," by Dr. E. Klein, p. 48 (McMillan & Co., 1884), Orth is quoted as having cultivated

artificially the micrococci of erysipelas, and afterward reproduced the disease in rabbits by inoculation. Fehleisen found the micrococci only in the lymphatics of the affected parts, and those he cultivated artificially for fourteen generations (which it took two months to do) on peptonized meat extract, gelatine and solid serum. The micrococci form a whitish film on the top of the nourishing material, and when inoculated into the ears of rabbits, a characteristic erysipelatous rash makes its appearance after from thirty-six to forty-eight hours, and spreads to the roots of the ears and further on to the head and neck. The animals do not, however, die from it. In the human subject he produced typical erysipelas after inoculation with the pure cultured micrococus in from fifteen to sixty hours. These inoculations were made for the purpose of curing certain tumors, one of lupus, one of cancer, and one of sarcoma. Fehleisen also in several instances carried out a second inoculation successfully, within a few months. He found that a three per cent. solution of carbolic acid and a one per cent. solution of mercuric bichloride destroyed the vitality of these micrococci.

That the material is also capable of being transmitted through the air, and of fixing itself upon wounds or abraded places, is proved by the strongest possible circumstantial evidence. This being admitted, the problem of prevention resolves itself into that of *exclusion* of the matter from contact with the susceptible part, or of destroying it between the moment of contact and the time of its development into disease.

The spray of carbolic acid as devised by Lister, acts probably not by destroying the septic microbes, nor by excluding them, but by rendering the conditions unfavorable for their development. The spray prevents the drying of the exposed wound surfaces; prevents the incipient changes which precede apparent decomposition, at the same time that the germs themselves are deprived of the surroundings most favorable for their development. In the meantime, the germs are destroyed by the white blood corpuscles before they have developed the conditions of attack. The drip or douche of carbolic acid, or of mercuric bichloride, acts in the same way to wash away or to neutralize the activity of such germs as may fall upon an exposed surface.

While this may be said of ordinary septic germs, it is not so certain that pathogenic germs, like those of erysipelas, can be neutralized by the action of a spray or a douche, if they are once implanted upon the surface of the living tissue.

These methods are liable to failure in cases of wounds of irregular surfaces, on which it is difficult or impossible to secure an adequate application to the whole surface of sufficient intensity and duration to destroy the invading virus. The exposure having been made, however, the chemical or the germicide agent is the only thing that can be relied upon to prevent the natural consequences of the exposure. The perpetual drip of a weak solution of carbolic acid (one per cent. solution) has been proved to be capable of preventing the development of erysipelas, and of other putrefactive changes detrimental to the healthy healing of wounds.

The perpetual bath, antiseptically medicated, is applicable to the feet and the fore-arms, and by lying in the water, it is applicable to the whole body, except the upper part of the neck and the head. Some very satisfactory results have been obtained by this method of management.

It must be admitted, however, that many wounds do not admit of the prolonged application of this or of any other agent capable of neutralizing an infection whose natural development is that of erysipelas or of putrefaction. Among these are wounds of joints and of the peritoneal and the pleural cavities and the cavity in the eye containing the aqueous humor. The agents of infection once introduced, the practitioner is at great disadvantage in the treatment of the case.

Much may be done by drainage and the introduction of disinfecting liquids, but it is necessary that they shall be of feeble force, in order not to irritate the delicate surfaces or not to poison the general system by absorption through the surfaces to which they are applied. It follows from these considerations, that the prevention by disinfecting agents should be the least favored method, and to be employed where the prevention by exclusion is impossible or has been neglected.

The *exclusion* is of two kinds: the immediate and temporary, and the permanent. 1st. The exclusion of those agents from the air which surrounds the patient at the time of an operation, by means capable of purifying the whole atmosphere of an apartment; and 2d. The permanent exclusion of an infected atmosphere by the mode of dressing.

This implies, that while the atmosphere of a whole room may be made aseptic during the time in which an operation may be performed, it may be too troublesome or too expensive to secure a perpetual purification of the apartment occupied by the patient during his recovery. It is implied that the exposed wound surface may be effectually secluded from contamination by such a character of the dressings as to make it certain that the infection will be arrested or destroyed.

We have our subject classified by the nature of things; as

1. Antiseptic applications during the progress of cure.

2. The arrest of the access of infection during the progress of cure by the character of the dressings first applied and allowed to remain.

3. The purification temporarily of the air of an apartment in which a surgical operation may be performed.

The plan of the first method is that of a perpetual irrigation, or a perpetual bath.

EXAMPLES.

The following case has not hitherto been published:

March 2, 1882, William Claypool, aged 15, shot himself through the lower end of the fore-arm with a shot gun, destroying a portion of the radius, and comminuting the ulna. Sensibility was only retained in the little finger and the ulnar side of the ring finger. In consultation with Drs. J. P. Walker, of Mason City, and M. Hurst, of Stillwater, it was determined to postpone amputation until after a thorough trial of the perpetual drip of a weak solution of carbolic acid. A solution, made so as to be sweet without smarting the tongue, was applied every twenty minutes night and day, until all dead material had separated from the living. The lacerated margins of the skin remained of the natural color, and no local or constitutional complication arose. At the date of August, 1885, more than three years after the time of the injury, there is motion in all the fingers and sensation in all but the forefinger, with surprisingly little deformity, to follow such an extensive comminution and laceration.

The second plan is that of a dressing impervious to the floating objects in the air, and it includes the "Lister dressing."

It is found that it is of no advantage to have the dressing air-tight or water-tight, but that a material with fine meshes, like that of cotton, will answer the purpose. If the wound is exposed under a spray or douche, and aseptic cotton, wool, or other similar material, be applied and retained, the agents of septic changes cannot enter as long as the material of the dressing is entirely dry. It is therefore convenient to have the cotton or other substance previously treated with a solution of mercuric bichloride or other antiseptic, the water being dried out before the use of the material for dressing. Otherwise the dressing, infiltrated with the exudations from the wound, becomes putrid, requiring its removal sooner than is necessary with a dressing capable of preserving from putrefaction any fluids that may get into it.

No better immediate application to a suture line can be thought of than castor oil holding ten per cent. of carbolic acid. Over this the elastic cotton or other material may be applied. The oil should be classed as a dry dressing, because it does not absorb water nor mix with it. In this connection it may be mentioned, that when it is desirable to maintain a fixed position by gypsum, mercuric bichloride may be dissolved in the water with which the plaster is mixed, in order that effusion or exudation from a wound may not be decomposed in the substance of the plaster.

The plan of the third class, is that of securing the freedom of a whole apartment from floating minute particulate material of all kinds during the time necessary for the performance of a surgical operation.

A paper on "Atmospheric Purification" was published in *The St. Louis Medical and Surgical Journal* for February, 1885. In that paper, a general review of what is known of organic material floating in the air, was given.

It is exceedingly probable that if the cavity of the peritoneum or any other closed cavity, can be opened in an atmosphere free from floating material, and closed again after a short period, the conditions will be the same as though the work of removing a tumor, or other operation, had been done subcutaneously so as to exclude the contact of air.

The continued purity of animal and vegetable liquids sterilized and placed in vessels closed by sterilized cotton, admitting free access of gases but sifting out particulate material, affords the strongest probability to the assumption that the septic changes occurring in wounds and in closed cavities into which air has entered, would not occur, if the air were free from such material as might be filtered out by passing through cotton or other material having fine meshes. Reasoning from the general facts here referred to, in relation to animal and vegetable fluids secluded from the floating material of the air, it becomes in the highest degree probable that the material of wounds would be equally exempt from change, if exempt from the contact of this floating material, and that if thus secluded, putrefactive changes would not occur. Wounds and injuries which are subcutaneous, show an exemption from septic changes, though a great amount of vascular and nervous disturbance may arise from the injury.

The use of douches and irrigations, is not for the purpose of purifying the air, but for washing away these minute particles, or rendering them inert by some influence upon them, thus rendering them less able to germinate, or, affecting the living surfaces, increasing their capability of resistance.

In the paper referred to, there was a description, with a wood-cut, explanatory of a device for purifying the air surrounding a patient while undergoing a surgical operation. This description is repeated here, with a new cut representing the latest modifications of the plan.

The room has now been in operation one year, and though the number of operations involving the opening of the serous cavities, is not sufficient for absolute proof, the probability is very strong, that the complete exemption from any septic condition attributable to exposure at the time of operation, is owing to the purity of the air.

I visited several cities of Europe in the summer of 1884, and had it in mind to observe what provisions were made toward the end of exemption from septic changes incident to surgical operations. I saw several new rooms with non-absorbable floors, walls and ceilings, yet having doors opening into the halls of hospitals. There were provisions for non-absorption of anything floating in the air of the apartment, but no provision for purifying the air.

At Hamburg, in connection with the female department of the general hospital, was a room just completed, having four outside walls, so that it was necessary to go through six feet of open air, to get from the hospital into it. There was evidence of great pains to secure the greatest possible

degree of cleanliness, but there was no provision for a better air than the outside atmosphere of a large city. I came home resolved to do something better than the latest improvement in Hamburg.

The room to be described is the result of my reflection upon the subject; and experience has suggested so many modifications of the apparatus, as to make a new cut necessary, in order to give a correct idea of the present arrangement, which now seems to realize every necessity for cool or cold weather. For hot weather, the current of air cannot be secured by heat produced in the operating room above, or in the room below, but must be obtained by a draft connected with a chimney operating as a *vis a fronte* (which is practicable in any hospital having a chimney which is in use in summer), or by a fan, operating as a *vis a tergo*, blowing air into the basement, which is to travel upward through the operating room.

Taking a hint from the observations recently made in Paris upon the effect of rainy weather upon the number of microbes floating in the atmosphere, it occurs to ask, whether or not it is practicable to subject the air entering an operating room to the influence of artificial showers in order to precipitate to the ground, the whole or the greater part of these enemies of surgery.

They are known to be heavier than the air, because they entirely disappear from the air within a tight box which has been for several months in one position. This principle of rest is of no use to us, for the purification of the air of an operating room by this means is impracticable. The commotion of the air incident to the use of a room must dislodge the minute particles from the floors and walls, and set them floating again in the air, besides permitting the entrance of common air from without.

The dry filtration by means of cotton or other substances to entangle and arrest the particulate material floating in the air, is not practicable, on account of the rapidity necessary in the entrance and exit of the air in order to displace the agents entering from without during the progress of an operation, and those emanating from the occupants of the room. If, however, we can cause the air entering the room to pass through several showers of water, we have an expedient which may entangle these objects and carry them to the ground.

The following is a description of such a device.

1. Basement.—On the floor at the right hand is seen a pot (3) for burning sulphur. It has under it a bunsen burner, though for quick use, in order to purify the room before an operation, the sulphur is usually made inflammable by mixing alcohol with it. On the right hand, in the wall, is an entrance ventilator or window, before which a steam jet is made to play in order to infiltrate the entering air with very fine globules of water. (2)

2. The air thus moistened passes in the direction of the arrows under a curtain or diaphragm reaching within fifteen inches of the floor. Under this curtain lies an iron pipe with numerous small holes drilled in the upper side, furnishing streams of water which strike the underside of a plank fifteen inches wide, and fall back in a shower of drops. The upper-side of the plank is the lower limit of the screen or curtain which divides this apartment from the next. It is thus necessary for all the moving air to pass through this artificial shower near to the floor and into the next room, warmed by the stove seen on the left hand of the diaphragm or screen. (5)

3. The air thus warmed, ascends to the ceiling, passing over the screen, (6) and then descends near to the floor, and passing under the screen (7) ascends as it passes back and forth under the shelves dripping with water, and finally through the spray which supplies this water. (8)

Thus there are three filtrations of the air, one by steam and two by water.

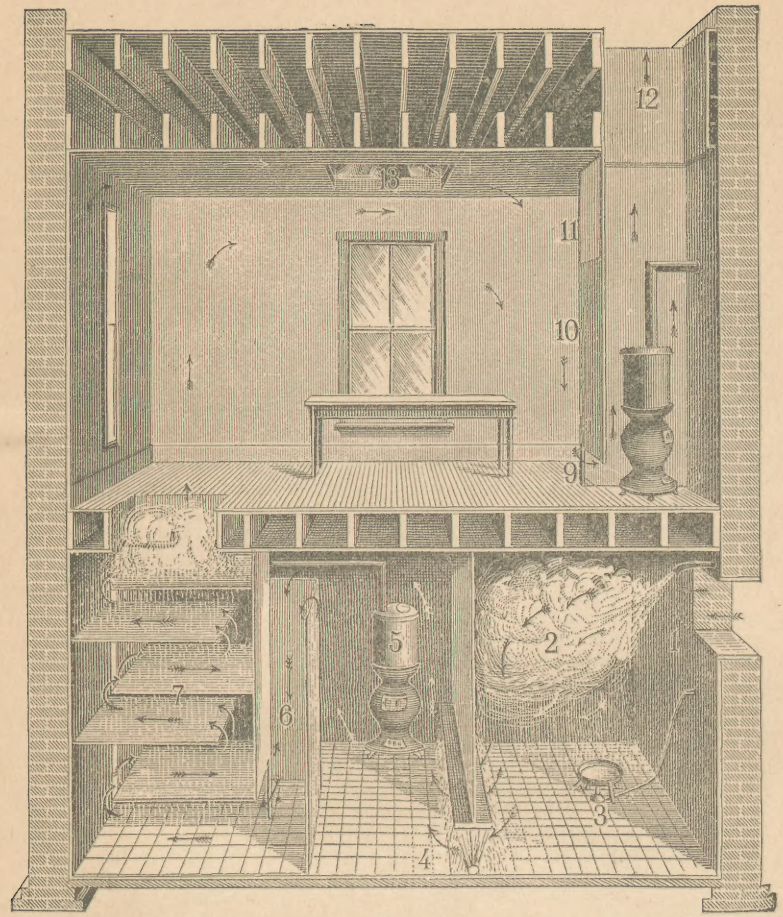


Fig. 1. Window admitting outside air.
Fig. 2. Steam for moistening all floating particles.
Fig. 3. Sulphur pot, with bunsen burner under it, for slow combustion. A more rapid combustion is secured by mixing alcohol with the sulphur.
Fig 4 Spray of water through which the air must pass in going to the next apartment.
Fig. 5. Stove for heating the air which has been once washed.
Fig. 6. Screen for forcing the air to pass from near the ceiling through the next washer.
Fig. 7. Shelves of thin muslin through which water drips from the spray in the opening in the floor above
Fig. 9. Entrance of the air of the room into the draught heated to hasten the rapidity of the escape.
Fig. 10. Stationary partition.
Fig. 11. Movable portion hinged above, and taking a horizontal position under 12, to close the exit through the roof, when the room is used without running the ventillating system.
Fig. 13. Sky-light.
An arrangement, not shown in the cut, secures a flow of warm moist air upon any part under operation. This air is washed by passing through a spray of water holding a solution of mercuric bichloride.

4. The air thus filtered three times, emerges through an opening in the floor and goes to the top of the operating room above.

5. Operating Room.—The exit ventilation is seen on the opposite, or right hand side of the room, in the direction of the arrows. This is effected by a movable shaft or box, made by tacking muslin upon a frame, with a stove inside the enclosure, and the arrow shows the progress of the air next the floor, which has been longest in the room, in its progress toward the stove behind the screen, by the heat of which its escape upward and out of the room is hastened. Fig. 10 is upon the body of the screen, and Fig. 11 is upon the upper portion, which swings upon the ceiling so as to take a horizontal position and close the exit shaft when the apparatus described is not in operation. Fig. 13 shows the opening for the skylight. The arrangement thus far is to get an atmosphere more pure than that outside, and through the frequent change of the air in the operating room, to get rid, to the greatest possible degree, of the contamination of the air (during the progress of an operation) produced by the emanations from surgeons, assistants, spectators, and the patient himself. This change is secured by the entrance of filtered air from the basement, and the exit, from the floor of the operating room, of the air which has been the longest in the room, having descended gradually from the ceiling where the air is hottest, after having entered from the warming chamber below.

6. The floor of the operating room is made of yellow pine, and filled with paraffine to as great a depth as heated smoothing irons can drive it. By this means, all cracks are filled so as to be non-absorbing. Under this, lies a layer of tarred paper upon a common floor upon the joists. Between the joists lies a layer of tarred paper upon the ceiling, the under side of which ceiling is painted, and lined with muslin while the paint is fresh. The muslin is again painted on the under side. The floor thus has seven layers, including the joists.

7. The operating room is free from closets where anything unclean can be hidden, and all wood work is either paraffined or painted.

8. There is no opening into any other room; about six feet of space intervening between the door of entrance and the nearest wall of the main building.

9. Before the use of the room for an operation involving the opening of a joint or the peritoneal cavity, it is intended that the rooms above and below shall be fumigated by sulphur burning in the basement. This is to be done for the destruction of any floating material of an organic character which may have gained entrance while the room may have been out of use. Among the disinfectants, Dr. Miller, of Dundee, Scotland, in *The London Practitioner* for 1884, in an article upon contagion, considers sulphurous acid (from burning sulphur) the most valuable of all disinfectants. Its vapor destroys every microbe, whether zymotic, septic or pathogenic. Its gas permeates every crack in the walls of a room, and its solution is easily applicable to the surfaces of solid bodies. Its only objectionable feature is the difficulty of employing it in rooms while people are in them.

10. This building is the execution of a theory of combining the best known expedients for securing the best possible atmosphere for surgical operations, by excluding noxious agents and by destroying or expelling those which may have stolen in, or which may be introduced by the patients, or by the surgeon and his assistants and guests. It is supposed that enough air will enter and escape to change the whole volume of air once in fifteen minutes. The exit draft coming from the floor will carry away most of the floating material.

11. The employment of a spray or douche of carbolic acid of the strength of 4 to 100, or of mercuric bichloride of 1 to 10,000, or other anti-

septics, locally applied, though less necessary than in an ordinary room, may yet be resorted to in order not to omit any useful precaution.

12. The employment of solutions of carbolic acid, mercuric bichloride or permanganate of potash with the nail brush for cleaning the hands, should be supplemental to the fixed provisions against septic and pathogenic particulate infection.

13. The bathing of the instruments in carbolized water; while this proceeding is incapable of disinfecting or destroying any germs which may adhere to them, may yet be useful in an antiseptic sense, *i. e.*, by destroying microbes in a developed state or freeing them from the supposed secretion by which they may be surrounded, and which may serve as their weapon of attack by which they digest or destroy the surfaces with which they come directly in contact.

14. A useful precaution on the part of the operator may be a bath, shaving the hair off the back of the hands and off the fore arms, and a change of clothing; the hair and beard being dampened so that dust will not escape from them; and yet another precaution may be the wearing of gowns which will oblige all dust escaping from the clothing of the operator and his assistants to fall to the floor whence it may escape with the draft which carries out the lowest stratum of the air.

The construction of an operating room on the principles here explained in a hospital already built, without erecting a detached building, would require that two rooms should be taken, one above the other, and if the upper one can have a skylight it will be of great advantage. The lower room might be in the basement, with a shaft not less than three (3) feet in diameter extending to the upper room which might be under the roof for the advantage of a skylight. All communications must be closed by brick and mortar, and an entrance opening made in the outer wall, the approach being secured by means of a platform on the outside of the building, so that it must be unavoidable to go into the open air for entrance and exit. The lower room should be equally shut off from communication with other rooms of the building.

TESTS OF THE PURITY OF THE AIR OF THE ROOM.

The first proceeding for a test, or for a use of the room for opening a joint or the peritoneal or the pleural cavity, is to burn a few ounces of sulphur in the basement. Afterward the steam is turned on, and the two sprays of water are set in operation.

The fire in the two stoves, one above and the other below, produces the increased lightness of the air necessary to make it rise.

June 28th, 1885, ten slices of freshly boiled potato were put upon small plates, covered with small tumblers, and sealed with a mixture of wax and paraffine. The plates, the covers, and the knife with which the potato was cut, were made aseptic by boiling.

Ten sealed flasks of culture liquid, kept since the cold weather, were opened, permitting the entrance of air to equalize the density of the inner and the outer air, kept open a few minutes, and sealed up again by melting the tips.

A bottle of culture liquid kept since cold weather by a cotton seal, was opened five minutes and sealed again with the same kind of cotton stopper.

Ten test tubes containing culture liquid, and sealed with cotton since last winter, were opened five minutes, and the cotton stoppers replaced.

One of the ten potato slices showed mould in a very few days, and two more later; of the latter one was yellow and the other brown. The remaining seven were free from change at the end of thirteen weeks. They all went into decomposition in four months, probably from the loosening of the wax and paraffine seal.

One of the flasks showed mould upon its surface in a few days, while the body of the liquid remained clear. The remaining nine of the flasks, were clear at the end of four months.

None of the test tubes became subject to decomposition.

The bottle of culture liquid (about 60 c. c. m.) did not go into decomposition.

August 16th. Seven weeks from the time of the preceding observation, the room was sulphurized and the motion of the air secured by a fan or Sturtevant blower, run by a gas engine.

The ten test tubes exposed seven weeks before were re-opened, and kept open for about half an hour, and closed again in the same way, without subsequent decomposition or mould.

Ten slices of potato were put up in the same manner as before.

Five slices of gelatine culture were prepared and put into test tubes sealed with cotton. The gelatine placed upon the slides was made by taking of fish glue, 20 parts; sugar, 1½ parts; water, 78½ parts; making a total of 100 parts. All the five slides took on mould, which appears to be the *sacchromyces mycoderma.*

Five potato slices showed discoloration, and five remained unaltered at the end of the third week, but all went into decomposition in three months. The test tubes, which had been re-opened and closed again, remained without alteration as noticed at the end of three months.

A speck of mould started upon the bottle containing the unused portion of gelatine, sealed with cotton, but this was sterilized by boiling, and remained without change as long as the cotton seal remained undisturbed.

It appears from these observations, that the spores of mould are the most difficult to eradicate, while they are the most innocent of all, as to surgical considerations.

Several operations involving the opening of joints have been made in this room, without any septic or erysipelatous sequel, and the peritoneal cavity has, up to the time of writing, Jan. 1st, been opened six times.

I. November 17th, 1884.—Mrs. S., 48 years of age, childless. A tumor was first noticed six months ago. Uterus low down in the pelvis, not moving by pressure upon the abdomen.

18th.—Cathartic and quinia 5 grains (.33 grams).

19th.—8 A. M. Tr. Digitalis 6 minims (.4 c. c.), Sulph. Clnchonidia and S. Quin. aa 10 grains (.66 grams).

Operation from 9 to 11; the pedicle being retained in the wound and held by Atlee's clamp. The adhesions were not important. The sutures were of silk, supplemented by long plastic pins with the twisted suture. The wound was dressed by a dry dusting of iodoform, carbolized oil, cotton, a pasteboard over the cotton, and adhesive strips over all, passing around the back.

In the shock immediately following the operation, there was a depression of temperature to 96° F. Eleven hours later the temperature had risen to 99°, and at no time afterward was it above 99 3-5°. There were nausea and vomiting on the second and third days, but the patient recovered in six weeks without any mishap. The urine was evacuated partly by a catheter left in, and partly by a catheter introduced at intervals.

For a few days after the operation, sufficient morphia was given to secure comfort, and from 5 to 10 grains of quinine were given daily to the completion of recovery. For a considerable time after the recovery, the patient complained, on moving about, of a drawing sensation attributed to the tension of the pedicle, but this ultimately passed away entirely.

II. Mary H., aged 17, in good health until the discovery of a tumor, a few months ago, which has had a rapid growth, beginning in connection with a fever, which she had in October 1884. The tumor extends three inches aboe the umbilicus.

Preparation by laxatives and quinia for two days before the operation, March 9, 1885, between 12 and 2.

A short incision was first made, and a trocar was introduced for evacuating the fluid. This failed in a great degree on account of its extremely multilocular character. The incision was then extended three inches above the umbilicus, and a sac with thin walls ruptured, spilling some fluid into the peritoneal cavity. After lifting out the mass which was not adherent except to the omentum, the short and flat pedicle was tied in four sections by a salicylitated silk ligature. Notwithstanding this, the principal vessel, after division of the pedicle, bled freely, spilling some blood into the peritoneal cavity. This vessel was twisted by pressure forceps, and the end of the pedicle was closed over by peritoneal membrane with catgut sutures. The outer portion of the oviduct went with the tumor, so that the outer end of its central portion became closed in with the end of the pedicle.

After sponging out the blood (not removing all the minute clots), the peritoneal lining on opposite sides of the wound was brought together by a continuous suture of catgut, and after this, a suture of the muscles was made with catgut.

With a theory of holding the pedicle to the suture line of the abdomen, so that in case of a possible abscess forming in connection with the silk ligatures, the ends of these ligatures which had been left long, were tied over the catgut sutures already mentioned, and then cut off short.

The cutaneous line of sutures was of three kinds, quilled, twisted and interrupted.

The wound was covered by pledgets previously soaked in carbolized oil, by sublimated cotton, by a pasteboard, and by a roller bandage.

The spilling of fluid from a ruptured sac, and of blood from an artery of the pedicle, should be put down as avoidable accidents.

The silk ligature to the pedicle, and its retention by this ligature to the suture line, must be regarded as a bad element in the proceeding, as will appear in the sequel.

The operation was preceded by the hypodermic injection of morphia, ¼ grain, and Tr. of Digitalis 10 minims. At the close of the operation the pulse was 150, the respiration 30, and the temperature 99 1-5°. Five hours later: Pulse 150, respiration 28, temperature 103 1-5°. Eight hours later: Pulse 134, respiration 36, temperature 101 3-5°

Four drops of Tinct. Veratrum Viride were given.

Sixteen hours: Pulse 132, respiration 36, temperature 103°.

Hypodermic injection of ¼ grain of Morphine; and a cold water coil was applied to the abdomen. The pulse, respiration and temperature were gradually reduced.

Twenty-two hours: Pulse 120, respiration 30, temperature 100°.

Morphine ¼ grain, Tinct. Veratrum Viride 4 minims.

Twenty-six hours: Pulse 130, respiration 23, temperature 98.6°.

The cold coil was discontinued.

On the fourth day there was a rise of pulse, respiration and temperature; pulse 140, respiration 25, temperature 102 3-5°, which subsided under the application of the coil laid upon the abdomen and carrying cold water. Sulph. Quinine in 5 grain doses was given every day.

The case progressed uniformly, the temperature sometimes rising and again subsiding under the influence of the cold coil, until the thirteenth day, when offensive pus was found escaping from the hole made by one of the pins of the twisted suture. A syringe was employed to cleanse the supposed small pus cavity, and the suture line was not opened up, as might have been done.

On the eighteenth day, in connection with a movement of the bowels,

secured by a cathartic, she became restless, and the pulse went up to 160, respiration 120, and temperature 104°.

After death, which occurred in twelve hours from the incipiency of bad symptoms, there was found an abscess around the pedicle closed in by adhesions, which had given way, permitting fetid pus to enter the general peritoneal cavity.

It is conceived that an abscess had formed in connection with the silk ligature, and traveled along a path made unintentionally by silk coming into contact with a pin of twisted suture. Had the case been understood earlier, and the abscess pumped out and washed with carbolized or borated water, and cathartics not given, it is probable that the case would have proceeded to a successful termination.

The improved practice; avoiding silk and using exclusively animal material for ligatures and sutures, thus greatly diminishing the danger of the formation of abscesses, will be explained further on.

This putrefactive complication came from the air of the room in which the patient lay, and not from the room in which the operation was made.

III. Mrs. P., aged 50, and mother of several children. The duration of the tumor is three years, and it has been tapped twice—the last time but little fluid was obtained. The patient has had several attacks of severe sickness, with abdominal tenderness, leading to the probability of finding adhesions.

May 18th, 1885.—A cathartic at bed-time.

19th.—Five grains of S. Quinine morning and at noon.

20th.—9:30 A. M.—The operation lasted one hour.

The omentum was found adherent to the whole anterior of the tumor, and to the abdominal wall, so that as the tumor came out, it left the peritoneal surface in a very rough condition.

The upper portion of the omentum was tied in two parts with whale tendon, cut off, and the stumps dropped into the abdomen.

The pedicle was enclosed with a tourniquet made of a piece of fishing line attached to a *Chassaignac ecrasseur* in place of its chain.

The flow of blood into the tumor was thus arrested, after which the pedicle was cut off close to the tumor. The open mouths of the vessels were pinched and twisted, and on relaxing the tourniquêt the bleeding vessels were squeezed and twisted again. The situation of the principal vessel was tied separately by whale tendon, and sutures were taken so as to cover the end of the stump with peritoneal surfaces, after which it was dropped back into the pelvis.

Some blood clots were taken out of the culdesac behind the uterus, and the other ovary was found to be healthy.

Some shreds of adhesion material were tied with whale tendon and cut off. The wound was finally closed without regard to a perfect "peritoneal toilette," believing that small blood clots will be disposed of like the sutures and ligatures. The wound was closed by four kinds of management:

1. The peritoneal surfaces of opposite sides were brought together by a continuous suture of whale tendon.

2. The muscular and adjacent tissues were brought into contact by a continuous suture of the same material.

3. The skin was closed by an over and over continuous suture of guitar string.

4. A through and through suture was made of fiddle string, a piece of rubber tubing protecting the skin as a modification of the quilled suture. All this animal suture and ligature material had been macerated in a solution of mercuric bichloride 1—1000 of water containing 10 per cent. of glycerine.

The patient had a hypodermic injection of Digitaline 1-50 grain (.0011) with S. Morph. ¼ (.014).

The extremities were kept warm by artificial heat. The anaesthesia was initiated by breathing 10 minims (.65) of Nitrite of Amyl with chloroform, after which ether was employed. A carbolic spray was kept playing upon the wound.

Before the operation the pulse was 80, the respiration 16, and the mouth temperature 97¾°. The exceeding thinness of the cheeks may account for the low temperature.

		Pulse.	*Resp.*	*Temp.*
	11:00 A. M.	96	—	97 3-5°
	12:00 M.	98	—	95°
	1:00 P. M.	94	18	94 3-5°
	4:30 P. M.	100	10	95°
	8:00 P. M.	96	9	96°
21st.	11:00 P. M.	96	2	98½°
	4:30 A. M.	104	18	98°
	6:20 A. M.	104	16	98½°
	9:30 A. M.	108	18	98½°
	12:30 P. M.	104	18	98°

The slow respiration is attributed to an extreme susceptibility to the effect of morphia. Otherwise the table is a good picture of shock.

5:30 P. M. Pulse 108, respiration 22, temperature 98½°

One-fourth grain of Morphine and one-fiftieth grain Digitaline injected hypodermically, slowing the respiration.

7:30 P. M. Pulse 108, respiration 11, temperature 98°.

9:45. Pulse 108, respiration 10, temperature 98°.

22d.—2:00 A. M. Pulse 108, respiration 12, temperature 98°.

One-twelfth of a grain of Morphine is to be taken by the mouth as often as there is evidence of pain or uneasiness.

	Pulse.	*Resp.*	*Temp.*
6:15 A. M.	108	12	98°
9:30 A. M.	116	16	98°
12:20 P. M.	104	18	99½°
5:15 P. M.	108	16	98½°
8:35 P. M.	116	14	99°
10:40 P M.	108	16	99°

The skin is of natural pliability, and the appetite is returning.

23d.—The cold coil is set to work.

	Pulse.	*Resp.*	*Temp.*
2:00 A. M.	108	12	98½°
6:30 A. M.	108	13	97¾°
11:40 A. M.	100	16	98°
8:00 P. M.	108	17	99½°

Good spirits; voice natural; appetite restored. The position on the back is carefully maintained. The urine is normal, and has been drawn at intervals of three hours, except while a catheter remained in the bladder. The cold coil was maintained only a short time. There was never a temperature above 99½°.

27th.—The wound was dressed at the end of a week.

29th.—Bowels moved with the aid of a cathartic.

July 4th.—The patient went home.

There was at no time any evidence of suppuration in the suture line. The external portion of the larger sutures became detached in from fourteen to twenty-one days. From other experience it is known that the whale-tendon disappears in from five to seven days.

This case shows that if a patient suffers from extreme shock, and recovers from it, the further progress may be as favorable as though there

had been no shock at all. The recovery of health became ultimately complete.

EXTIRPATION OF THE UTERUS AFTER THE METHOD OF FREUND.

IV. Mrs. J., aged 39, having had an epithelial degeneration of the os uteri two years, and having had removal of the morbid growth in August 1884, and again a thorough removal in April 1885, and having a return of the growth with repeated hemorrhages, yet having a fair degree of vitality, submitted to the operation July 13, 1885.

The cavity of the uterus was three inches, and the whole organ movable.

The examination of the uterus *post mortem*, however, showed that the neck and the lower part of the body was enlarged, and that the disease extended into the broad ligaments.

The patient died of shock twenty-eight hours from the close of the operation, without having had any reaction. There was not, however, an extreme fall of temperature, 96½° being the lowest, fifteen hours from the close of the operation.

The operation was done by an incision from the umbilicus to the pubes. The broad ligament was seized with forceps and tied with ligatures of fiddle string intended to remain permanently, and on the inside of the ligatures the broad ligament was cut. Then deeper ligatures were applied and a cut made on the median side of them, pressure forceps being employed to arrest any bleeding until the vagina was reached. The uterus was carefully dissected from the base of the bladder, and the vagina itself was cut and partly torn, and the uterus was lifted out. There was found to be such a thickening of parts by morbid deposit, that the opening into the vagina could not be satisfactorily tied with sutures.

The following are the steps of the operation and the time:

9:15	A. M.	The commencement of anesthetization.
9:36	"	First incision.
9:40	"	Peritoneum opened.
9:50	"	First ligature on the broad ligament.
9:53	"	Second ligature on the broad ligament.
10:02	"	The first cut in the broad ligament.
10:15	"	Both broad ligaments cut.
10:27	"	Hypodermic injection of { Cocoaine, .020. Digitaline, .001. S. Morph., .014.
11:03	"	Uterus removed.
11:06	"	Suturing begun.
11:18	"	Suturing completed.
11:24	"	Dressing completed.

The whole time, 2 hours and 9 minutes.

If the diagnosis of the extent of epitheliomatous infiltration had been made, the operation would not have been undertaken.

The proceeding in this case, showed the practicability of making such an operation as might be safe to life, if the uterus were the only seat of disease.

The patient died of shock and not from any impurity of the air to which the peritoneal cavity was exposed. The amount of blood lost was very small.

The experience of this operation showed that the change of air contemplated by means of its rarefaction by heat, which is felt in the operating room, is impracticable with an outside temperature of 90°, as was the case on this day. To remedy this difficulty, an arrangement has been made to blow air into the basement by a Sturtevant fan, which is run by an engine. A room in a large establishment can have an exhaust connected with a smoke stack, which will secure a change of air, and fulfil the

indication of frequent change of purified air.

V. Mrs. S., aged 31, confined with her third child three months ago, when it was discovered that she had an ovarian tumor.

Several attacks of severe pain led to the suspicion of the existence of adhesions. The violence of these attacks, some of which were of a colicky nature, led her to submit to an operation.

The night before the operation the pulse was 83 and the temperature 98 3-5°. A cathartic was given, and no breakfast allowed. The morning before the operation, 10 grains (.65) of Quinine were taken in place of the breakfast.

1. Nov. 11th, 1885.—An incision was made in the median line, four inches in length, not reaching up to the umbilicus.

A considerable amount of ascitic fluid escaped as soon as the peritoneum was incised.

A Spencer Wells trochar was then introduced, nearly evacuating the tumor.

The flaccid tumor was lifted out, carrying with it a portion of the omentum, and some loops of intestines, which were immediately covered with a towel wet with warm carbolized water.

2. The pedicle was next clamped by a cord, which was a piece of fishing line, attached in place of the chain, to a *Chassaignac's ecrasseur*. It is suggested that a strong silk braid makes a better cord than that here employed.

The pedicle was next cut off close upon the tumor, including the oviduct.

3. After pinching with pressure forceps what appeared to be the mouths of vessels, the raw surface was covered with peritoneum by sewing, with fine whale-tendon, the opposite peritoneal edges, making a continuous suture. A ligature of aseptic fiddle string was then applied for additional safety, after which the pedicle was dropped into the pelvis.

4. The adhesions were cut off one after another and treated the same way. One intestinal adhesion was so close that a portion of the tumor was left upon the intestine. The surface of this was scraped and sewed in, so that no part was left uncovered by peritoneum.

5. The wound was closed by four lines of suture: First, the peritoneal surfaces by a continuous whale-tendon suture; next the muscular and connective tissue in the same way; then a continuous cutaneous suture, the needle being passed deep into the tissues, carrying a portion of aseptic fiddle string; and, lastly, a fine continuous suture of whale-tendon, in order to secure an accurate closing of the cutaneous margins.

6. Iodoform was dusted upon the surface; then carbolized oil was applied; then sublimated cotton of considerable thickness; next a pasteboard, to afford a good surface for the bandage; and next, a roller bandage of adhesive plaster, covered by a muslin roller bandage; and over all this, finally, an elastic rubber bandage. This latter is generally applied for temporary pressure upon the abdominal contents, to be discontinued in a few hours.

At 10:45 A. M., after the dressing was completed, there was a hypodermic injection of S. Morph. ½ grain (.033) with Digitaline 1-50 grain (.0013).

11:45 A. M. Pulse 80, temperature 98°. From this absence of depression of temperature, it appears that there was very little shock.

2:00 P. M. Pulse 110, temperature 100°.

6:00 P. M. Pulse 96, temperature 101°.

The employment of the cold water coil was commenced and continued all night.

12th.—12:30 A. M. Pulse 104, temperature 100 2-5°.

2:00 A. M. Pulse 108, temperature 101 1-2°.

The temperature never rose above this. The convalescence was uninterrupted, and the patient went home in four weeks.

Sufficient Morphia was given to counteract any sense of discomfort. Quinine was administered every day, and the bowels were kept open by the daily use of a pill containing aloes, nux vomica and belladonna.

VI. Mrs. M., aged 43, mother of several children, first became aware of a tumor eleven months ago. The tumor proved to be very multilocular, weighing 10 pounds. There was a larger weight of ascitic fluid than of the tumor itself.

The incision extended from the pubes to a point two inches above the umbilicus, revealing a tumor of an elliptical shape.

After the escape of a large amount of ascitic fluid, the pedicle was clamped, as in the preceding case; cut off next the tumor, after which the tumor was drawn out from the abdomen, presenting its shortest diameter transversely to the incision, after which a considerable omental adhesion was cut and sutured, so as not to present any surfaces uncovered by peritoneum.

The extremity of the pedicle was then treated as in the last case. A small artery was found spouting, having slipped out from the grasp of the clamp. This was tied without much delay, and concealed under the serous covering by sutures.

The ascitic fluid was not completely removed from among the intestinal folds, thinking that under the antiseptic precautions, the presence of the fluid was a less evil than the contact of sponges. A careful "peritoneal toilette" was not attempted.

The wound was closed as in the last case, there being nothing but animal substances employed for ligatures and sutures. In two weeks the ends of the sutures outside of the skin came off, and on the 28th day, December 23d, the patient went home.

It will be interesting to follow the symptoms a few days.

Nov. 24th.—A cathartic.

Nov. 25th.—Quinine 20 grains (1.29) in the morning.

10 A. M. Pulse 84, respiration 16, temperature 98 1-2°.

Two days before the operation the pulse had been 108, and the temperature 101°, after riding 200 miles.

Previously to the operation, a hypodermic injection was given of S. Morph. ¼ grain (.016) and Digitaline 1-5 grain (.0013).

From the commencement of anesthetization to the completion of the dressing, one hour and ten minutes, ending at 2:20 P. M. A pulse of moderate volume was maintained.

	Pulse.	*Resp.*	*Temp.*
2:10 P. M.	116	16	98°
4:00 "	101	16	97°
5:00 "	122	16	98°
6:00 "	128	16	98 1-2°
7:00 "	138	17	99 2-5°
9:00 "	128	18	99 2-5°

She complained of tightness and the rubber bandage was removed.

26th.—2 A. M. The patient has vomited twice since the operation. Pulse 118, respiration 18, temperature 99 2-5°.

A hypodermic injection of S. Morph. ½ grain (.032).

	Pulse.	*Resp.*	*Temp.*
8:00 A. M.	120	20	99 3-5°
9:00 " Injection of Morph. ¼ gr. (.016)			
11:00 "	126	22	100°
3:00 P. M.	128	26	101 1-5°
5:30 " Morphia injection ¼ grain (.016).			
7:00 " The cold coil upon the abdomen began to circulate cold water.			

8:00 P. M. Pulse 130, resp. 22, temp. 102°.

Morphia ¼ grain (.016) by the mouth.

9:20 P. M. Pulse 120, resp. 22, temp. 100 4-5°

12:00 M. Morphia ¼ grain (.016); no more hypodermic injections were given,

29th.—2:30 A. M. Pulse 138, resp. 22, temp. 100 4-5°.

8:45 A. M. Pulse 140, resp. 24, temp. 99 1-5°.

Tinct. Veratrum Viride given in a dose of 4 minims (.26). She sleeps the larger part of the time, and is free from any expression of pain.

1:40 P. M. Pulse 132, resp. 24, temp. 98 4-5°.

The appetite for ice has diminished, and she has taken a little beef tea. Morphia ¼ grain (.016). The coil is discontinued.

6:00 P. M. Takes a little milk with whiskey. Pulse 144, resp. 26, temp. 99 1-5°.

8:00 P. M. Morph. ½ grain (.032).

9:40 P. M. Pulse 132, resp. 26, temp. 99°.

28th.—8:10 A. M. Pulse 144, resp. 26, temp. 99°. Sulph. Quinia 5 grains (.32). She takes some milk and whiskey.

1:20 P. M. Pulse 148, resp. 26, temp. 99°. Takes a little coffee and toast. Fl. Ext. Digitalis 6 minims (.39).

3:00 P. M. Pulse 124, resp. 26, temp. 99°.

It is interesting here to note the apparent effect of the Digitalis, reducing the rate of the pulse twenty-four beats in one hour and forty minutes, or about one beat to four minutes, without changing the rate of the respiration or the grade of the temperature. The pulse remained permanently stronger, and less frequent, and nothing more occurred to occasion any anxiety.

Morphia was exchanged for cordeia; 1 grain being given whenever there was any expression of pain, and Fl. Ext. Digitalis in 1 drop doses once every hour; afterwards once in three hours, for a few days.

Quinine was given in doses of 5 grains (.36) three times a day, and three times a day a pill prepared by McKesson & Robbins, containing

Aloine, - -	1-5 grain (.0150)
Strychnine, - -	1-80 grain (.0008)
Ext. Belladonna -	1-8 grain (.0080)
Ext. Cascara Sagrada, -	1-2 grain (.0320)

The urine was drawn once in three hours, or permitted to run through a catheter held in the urethra.

In all the operations here detailed, the steam spray with carbolic acid was employed while the wound was open, in order to keep the surfaces moist, and in a condition most likely to destroy by their secretions, any septic agents which might, by any possibility, gain entrance.

VII. Mrs. B., aged 52, widow, never having been pregnant. It is eight months since the discovery of something wrong in the abdomen.

Before operation, pulse 76, respiration 28, temperature 98°.

Feb. 3d, 1886.—Operation in the same manner as already described, employing only animal sutures and ligatures.

The tumor was multilocular, not admitting of much diminution by trochar, and requiring an incision ten inches in length.

The lowest temperature of shock was 95 4-5°, fourteen hours after the operation.

The highest temperature reached was 102°; for a short time on the sixth day.

The cold coil was applied when the temperature approached 100°, and kept on until the reduction of the temperature and the comfort of the patient required its removal.

Ninth day.—The patient has been thoroughly purged, to relieve a diarrhœa believed to depend upon an imperfect evacuation of the colon.

Pulse 98, respiration 30, temperature $99\frac{4}{5}°$.

15th day. The abdominal tenderness has disappeared, but the patient is troubled with anorexia, nausea and diarrhoea.

The wound is dressed for the second time. On the first dressing the union seemed to be perfect, except a suppuration at the lower end. Now the parting of the cutaneous adhesions has extended and a similar opening appears at the top.

Pulse 104, respiration 24, temperature 98°.

16th day. Pulse 100, respiration 24, temperature $97\frac{5}{10}°$ in vagina.

Smoked with relish for the first time since the operation.

A suppository of cocaine .13 arrested the diarrhoea.

The anorexia continues.

A suppository containing morphia .016 and cocaine .13 was introduced twelve hours after the first one.

17th day. She took a teaspoonful of egg nog every hour during the night. A change of the dressings reveals two points of suppuration, one at either extremity of the suture line.

Pulse 120, respiration 28, temperature 98° in mouth.

Some hypodermic injections of whiskey, 20 minims (1.30 c. c.) each, were given, reducing the pulse from 130 to 120 beats in a minute.

18th day. Pulse 140, respiration 28, temperature 98° in vagina, falling in the course of the day to $97\frac{3}{5}°$.

The pulse became gradually weaker, the extremities colder, with clouding of consciousness till death, at 8:30 P. M.

POST MORTEM.—The suture line in the peritoneum was found to be perfect without any communication with the peritoneal cavity, but the space above the muscles, was full of pus from one end to the other.

On going through the peritoneal suture the intestines were united to the abdominal wall and to each other by firm adhesions, and it was at first supposed that there could be no pus in the peritoneal cavity. On going through this layer of adhesions, however, several purulent collections were found bounded by adhesions and free from odor, except one, which communicated through an ulcerated opening with the intestinal canal. From this purulent collection bubbles of air came with an offensive odor. But for this opening, these purulent collections might have been ultimately absorbed or encysted and the patient might have had a protracted convalescence.

The non-putrefactive character of these collections, which had no atmospheric communication, is an encouraging fact in connexion with an attempt to surround the wound while open, with an aseptic atmosphere.

VIII. Mrs. S., aged 26. She has had two children, the youngest being four years old. The tumor has existed five years. The last menstruation was on the 14th of December.

The operation was upon the plan already described, only that in place of Lister's spray a volume of air was made to blow directly upon the abdomen after having been passed through a spray of warm water. The tumor had a single cyst and weighed, with its contents, forty-three pounds.

There was a large area of adhesion to the anterior abdominal wall which required a considerable time for dissection. The clamping of the pedicle and its separation before removing the tumor, facilitated the manipulation of the tumor during the separation of the adhesions and prevented any bleeding from the tumor side. By cutting close upon the tumor, the amount of hemorrhage was reduced to the lowest possible amount. The pregnant uterus was interfered with as little as possible.

4th day. The appetite has not yet returned. Several hypodermic injections of morphia have been made, each containing .016.

Pulse 108, respiration 24, temperature $98\frac{1}{2}°$.

The cold coil has been kept on as long as the temperature has been 100 or over.

9th day. All tenderness has disappeared and the appetite is good, with good digestion. The bowels have moved without a special cathartic.

13th day, 8 A. M. An abortion occurred.

9 A. M. A chill was checked by a hypodermic injection of morphia .016.

Pulse 130, respiration 24, temperature $101\frac{1}{2}^{\circ}$.

The cold coil was applied for a short time.

2:30 P. M. The adhering placenta was removed.

5:30 P. M. Pulse 120, respiration —, temperature $95\frac{1}{2}^{\circ}$.

8.45 P. M. " 118, " 20, " 96°.

10:00 P. M. " 120, " 22, " $97\frac{1}{2}^{\circ}$.

14th day, 6:45 A. M. Pulse 124, respiration 26, temperature $99\frac{4}{5}^{\circ}$.

9:00 A. M. Vagina was washed out with carbolized water.

11:30 A M. Pulse 124, respiration 28, temperature $102\frac{1}{10}^{\circ}$.

Cold coil applied and hypodermic injection of morphia .016.

12:00 M. Pulse 124, respiration 28, temperature 101°.

A fall of $1\frac{1}{10}$ degrees in half an hour.

This is a good illustration of the course of shock manifested in temperature without disturbance of the respiration, and without more acceleration of the pulse than the loss of blood may account for.

The only symptom occasioning anxiety has been the extreme vomiting occurring on the fifth and sixth days. The redeeming feature was the existence of a desire for food at the same time that it was speedily rejected.

The fact of the existence of pregnancy helps to put this symptom into that classification. The administration of oxalate of cerium was followed by an amelioration of the vomiting.

March 30. The patient has made a good recovery without further complications.

The room which has been described has been used for the performance of a great variety of operations and no septic complication has arisen which could not be accounted for by exposure of the wound to the air of the room afterward occupied by the patient.

It is believed, therefore, that the task of avoiding exposure to septic influences during an operation has been fully accomplished.

The dangers that remain are shock, immediate or delayed, non-putrefaction suppurations and consequent perforations, putrefactive suppurations entering by sutures, and the developments of disease dependent upon various diatheses.

The hypodermic injection of Morphia .016, Atropia .0011, with Tinct. Digitals .30, may aid in averting shock, and the same combination may aid afterward in the recovery from shock. The securing of proper warmth, especially of the lower extremities, is important with the view of the prevention of shock. The greatest possible exemption of the peritoneal surfaces from irritation should be observed, even though some blood clots escape removal and remain to be disposed of as if they were sutures or ligatures.

Writers upon special departments, often indulge in the announcement that operations, which are likely to fail or prove fatal if badly managed, should only be undertaken by those who have done them often. It must be confessed that the familiarity with the technics of special proceedings, favors speed, and thus helps to exempt from shock, but it may at the same time be claimed, that familiarity with the general principles involved in the successful management of wounds, of whatever sort, has more to do with general success, than the dextrous procedure through a routine operation.

It is coming to be recognized that however great the skill, it will often fail without cleanliness. The cleanliness which can inspire confidence, must be not only from impurities which can be seen and washed

away, but also from that which floats invisible in the air. Any good surgeon ought therefore to make a good operation of laparotomy, if he has a proper conception of septic dangers and the means of avoiding them.

In a statement before the French Surgical Congress meeting in Paris, in April, 1885, (*Revue de Chirurgie*, March, 1885, page 359,) by M. Abadie of Paris, in the course of extended remarks upon this subject, are the following paragraphs:

"A factor of the greatest importance is the microbic element. I can easily demonstrate this by taking the experience of ophthalmic surgeons, when, after an operation for cataract, there occurs suppuration in the eye, This complication should not be attributed to some influence of diathesis, but to some infecting cause. The essential condition is local and external.

"Previously to antiseptic practices, it was remarked, that suppuration did not occur after iridectomy, though a frequent accident after cataract extraction. The reason is, that after the operation for cataract, the aqueous humor is modified so as to contain more albuminoid material, becoming a better medium for culture, and of the multiplication of the microorganisms of suppuration.

"At this time, I think that sufficient care is taken of one's person, of those of assistants, and of instruments, but the atmospheric medium of the operation is neglected. The best protective dressings are applied too late, if the inoculation has already been made. The air in which we live is surcharged with microbes in innumerable quantities, which hasten putrefaction and interfere with the regular development of cicatrization."

This is extravagant, because we know that eyes are lost from injuries in which the external membranes are not ruptured and from diseases which arise spontaneously. An operation made, however aseptically, upon an eye about to go into destructive degeneration, must terminate disastrously.

There is no doubt, however, that most of the eyes that are lost after operations, might have been saved by the avoidance of the entrance of floating atmospheric particulate material.

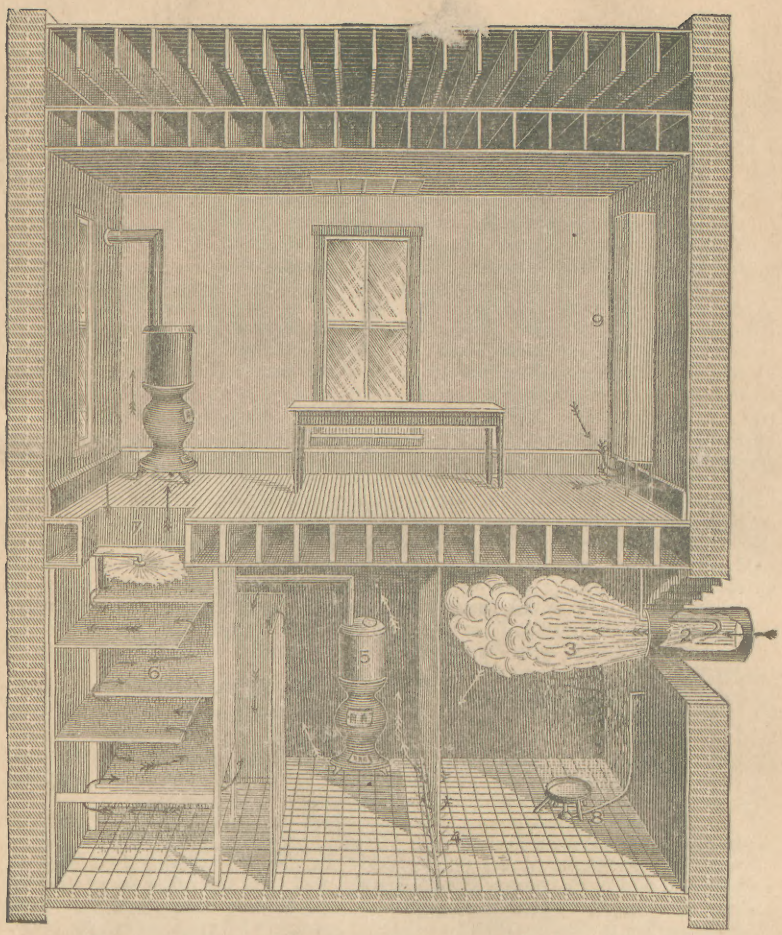
The following statistics are interesting in this connexion:

Dr. Arthur E. Prince has made cataract extractions on thirty-five eyes in this room since its opening in November, 1884, without a case of corneal ulceration among them. In each case, an ointment of iodoform, two parts in a hundred of vaseline, was introduced into the conjunctional duplicatures before the application of the bandage.

Of a series of sixteen cases performed successively in the patients homes, or in other rooms in this private hospital, the first and last eyes were lost through corneal destruction. In the last patient belonging to this list, a lady 85 years old, one eye did well and the other went into destructive inflammation, resulting in pain, high temperature and delerium, terminating in death. The two lists added make fifty one, of which forty-nine in succession were successful.

The greatest pains have uniformly been taken with the instruments, to avoid the introduction of septic agents during the manipulations; the iodoform being relied upon to prevent subsequent infection. It is impossible, however, to prevent the entrance of a little air into the wound while the lens is escaping. This is ordinarily absorbed, as is the case with a globule of air introduced in a hypodermic injection, but in the one case as in the other, infectious germs may once in a while start destructive inflammation. This experience is of great interest, revealing a source of danger in operations upon the eye, which has hitherto generally escaped recognition.

This paper is given to the public as a contribution toward greater success in surgery, through the exclusion of an invisible enemy, which, until recently, has not even been concieved of as the cause of putrifactive changes in wounds.



Basement below and Operating Room above—Scale, one to sixty.

This is the first design and it is inserted here to show the progress made in the adaptation of means to meet the necessity. Since the execution of the cut on page 6, another device has been introduced to meet the objection that the air is necessarily contaminated by emanations from persons in the room at the time of an operation.

This device consists in a special washing of air by a spray of warm sublimate water, which is carried in a pipe to a proper height (about eighteen inches) above the portion of the body upon which a wound is in progress. This warm and moist air falls upon the wound to the exclusion of other air in the room, and instead of blowing upon the wound any dust, it necessary excludes all floating material, holding its particles upon the outer part of the stream where it is commingling with the surrounding air.

It is believed that by this arrangement it is practicable to obtain an absolutely aseptic air on a sufficiently large scale for the necessities of any surgical operation.

It is probable that a little mercuric bichloride will be carried over in the stream of air as it passes the sublimate spray, but it will not be sufficient in amount or continued long enough to be poisonous from absorbtion into the circulation.